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(54) Title: ORIENTED POLYPROPYLENE FILMS FOR ADHESIVE TAPE (54) Titre: FILMS DE POLYPROPYLENE ORIENTÉ POUR RUBAN ADHESIF			
<p>(57) Abstract</p> <p>An adhesive tape (10) comprising a backing (11) and a layer of adhesive (18) on the backing. The backing comprises a biaxially oriented substrate which comprises an isotactic polypropylene composition. The tapes and backings of this invention can be severed readily using commercial tape dispensers having metal or plastic cutting teeth to produce cleanly serrated cut edges on the tape. The biaxially oriented substrate is preferably made from a resin comprising an isotactic polypropylene homopolymer having a melt flow rate greater than 8 grams/10 minutes, more preferably greater than 12 grams/10 minutes, and still more preferably greater than about 20 grams/10 minutes. One preferred way to obtain such a resin is to blend: A) at least one isotactic polypropylene homopolymer "A" having a weight average molecular weight of at least 350,000 grams/mole and melt a flow rate of about 0.5-8 grams/10 minutes, more preferably about 0.5-5 grams/10 minutes; with B) at least one isotactic polypropylene homopolymer "B" having a weight average molecular weight of at least 100,000 grams/mole and a melt flow rate greater than 8 grams/10 minutes, and preferably greater than about 20 grams/10 minutes, and more preferably greater than about 50 grams/10 minutes.</p>			
<p>(57) Abrégé</p> <p>L'invention se rapporte à un ruban adhésif (10) comportant un support (11) recouvert d'une couche d'adhésif (18). Ledit support comporte un substrat à orientation biaxiale qui comporte une composition de polypropylène isostatique. Les rubans et les supports de cette invention peuvent être facilement coupés au moyen de distributeurs de ruban du commerce qui sont pourvus de dents coupantes en matière plastique ou en métal qui permettent de former des bords dentés, coupés correctement, sur le ruban. Le substrat à orientation biaxiale est de préférence constitué d'une résine comportant un homopolymère de polypropylène isostatique présentant un coefficient d'écoulement à l'état fondu supérieur à 8 grammes/10 minutes, de préférence supérieur à 12 grammes/10 minutes, et idéalement supérieur à 20 grammes/10 minutes. De préférence, on produit cette résine en mélangeant (A) au moins un homopolymère de polypropylène isostatique "A" ayant un poids moléculaire moyen d'au moins 350 000 grammes/mole et un coefficient d'écoulement à l'état fondu compris entre 0,5 et 8 grammes/10 minutes, de préférence compris entre 0,5 et 5 grammes/10 minutes, et (B) au moins un homopolymère de polypropylène isostatique "B" ayant un poids moléculaire moyen d'au moins 100 000 grammes/mole et un coefficient d'écoulement à l'état fondu compris supérieur à 8 grammes/10 minutes, de préférence supérieur à 20 grammes/10 minutes et idéalement supérieur à 50 grammes/10 minutes.</p>			

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(54) Title: ORIENTED POLYPROPYLENE FILMS FOR ADHESIVE TAPE				
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An adhesive tape (10) comprising a backing (11) and a layer of adhesive (18) on the backing. The backing comprises a biaxially oriented substrate which comprises an isotactic polypropylene composition. The tapes and backings of this invention can be severed readily using commercial tape dispensers having metal or plastic cutting teeth to produce cleanly serrated cut edges on the tape. The biaxially oriented substrate is preferably made from a resin comprising an isotactic polypropylene homopolymer having a melt flow rate greater than 8 grams/10 minutes, more preferably greater than 12 grams/10 minutes, and still more preferably greater than about 20 grams/10 minutes. One preferred way to obtain such a resin is to blend: A) at least one isotactic polypropylene homopolymer "A" having a weight average molecular weight of at least 350,000 grams/mole and melt a flow rate of about 0.5-8 grams/10 minutes, more preferably about 0.5-5 grams/10 minutes; with B) at least one isotactic polypropylene homopolymer "B" having a weight average molecular weight of at least 100,000 grams/mole and a melt flow rate greater than 8 grams/10 minutes, and preferably greater than about 20 grams/10 minutes, and more preferably greater than about 50 grams/10 minutes.				

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Description

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Oriented Polypropylene Films for Adhesive Tape

TECHNICAL FIELD

The present invention generally relates to biaxially oriented films made from polypropylene and tapes comprising such films.

BACKGROUND OF THE INVENTION

Commercially available pressure sensitive adhesive tapes are usually provided in a roll form on a tape dispenser (see e.g. U.S. Patent Nos. 4,451,533 and 4,908,278). Tape dispensers typically have either a metal or plastic serrated cutting blade. "Severability" of adhesive tape is defined as the ability to cut or sever a length of tape by pulling the tape over the teeth on the serrated cutting edge of a tape dispenser with a desired amount of energy or work. Severability is also referred to as "dispensability."

It is desired that the severed tape does not chip, sliver, fracture or break in an unpredictable manner (see U.S. Patent Nos. 4,451,533 and 4,908,278). Such severability is desirable to produce a cleanly serrated cut edge on the severed tape strip. Severability is governed primarily by the mechanical properties of the backing of the adhesive tape. Cleanly serrated edges are preferred for aesthetic reasons in applications such as gift wrapping, mending, and the like. The ease with which an adhesive tape can be severed depends on the deformation and resistance to break (toughness) of the tape backing film, also referred to as the substrate. Typically, the substrate is coated or laminated with surface layers to provide an adhesive surface or a matte or writable surface. The greater the energy required to sever the film, the more extensive the resulting damage to the film will be and the less aesthetically appealing the resulting severed edge. In most cases, energy to sever of the tape is governed primarily by the substrate, with little affect by the adhesive or other layers or coatings. This is believed to be due in part to the elastic strain energy built up during the deformation being suddenly and catastrophically released when the film's inherent strength limit is surpassed. The subsequent failure propagates uncontrollably in a tearing or ripping fashion so that the cut edge does not follow closely the contour of the teeth of the dispenser. The propagation also is directed along the underlying fibril orientation distribution rather than closely following the contour of the dispenser teeth.

5 The majority of commercially available biaxially oriented polypropylene film is
produced by the flat film or tenter stretching process. Typical tenter processes serve to
biaxially stretch films either predominately simultaneously or predominately sequentially.
10 Sequential tenter stretching is currently the most widely used biaxial film processing
method. Typically, a thick sheet is extruded and rapidly quenched to form spherules
having α -morphology with a monoclinic unit cell. This thick sheet is then reheated to a
suitable stretching temperature and stretched in a first lengthwise or longitudinal stretching
15 step, followed by a second transverse stretching step and then the film is annealed to
produce a flat film having uniform thickness. Simultaneous tenter stretched films
20 comprise a minor part of the film backing market because, although such processes can
continuously stretch films in both longitudinal and transverse directions, they have
historically proven costly, slow, and inflexible regarding allowable drawing ratios.

25 Commercially available biaxially oriented polypropylene films are well known for
their toughness, moisture stability, good color, slivering resistance, and clarity and have
30 long been used as adhesive tape backings (see U.S. Patent Nos. 3,241,662 and 3,324,218).
35 Such films are produced typically with so-called "film grade" isotactic polypropylene resins
having high molecular weight and low melt flow rates between about 2-8 grams/10
minutes as measured using ASTM D 1238-95.

40 High molecular weight polyolefin resins are well known in the art to produce
45 biaxially oriented film having uniform stretch and thickness, without hardbands, wrinkles
or other defects. High molecular weight imparts cohesive strength to the cast sheet,
allowing uniform stretching at the strain rates typical of commercial biaxial film stretching
equipment, especially the high strain rates that can occur in sequential biaxial orientation
50 film lines.

55 However, especially in the sequential biaxial orientation case, high molecular
weight produces film having high toughness, and adhesive tapes produced from such films
tend to elongate significantly before breaking while under load, which renders such tapes
extremely difficult to sever, particularly on a plastic-bladed dispenser. The elongation to
break for such tapes results in an undesirably large amount of work on the part of the user.

60 It is known to add other components to polypropylene resin to improve
processability or improve severability for production of adhesive tape backing films.

5 Small amounts (less than about 10% by weight) of low molecular weight additives
like waxes or lubricants can be employed to allow the cast web to be more easily stretched
to a film by reducing the internal friction between polymer chains as they slide past each
other. WO 97/46369 discloses use of a polypropylene wax additive, by which the
10 10 execution of a process for preparing a biaxially stretched polypropylene film at high
speeds and with high reliability will be possible.

15 Components like hydrocarbon tackifiers, high Tg polymers and the like can be
added to enhance the film brittleness and thereby reduce the work required to sever the
film. Such materials may prove difficult to process or impart undesirable stiffness,
10 10 opacity, off-colors, and higher cost to the finished film.

20 JP 53-34834 discloses a biaxially oriented polypropylene based adhesive tape with
cutting properties formed from a polymer mixture containing 20-80% of polypropylene
and 80-20% of a low molecular weight polyolefin. It is further disclosed that in the case
when the molecular weight of the low molecular weight polyolefin becomes greater than
25 15 20,000 grams/mole, it becomes a material where the cutting properties are significantly
deteriorated.

30 U.S. Pat. No. 3,887,745 discloses a finger-tearable adhesive tape with a film base
comprising a layer of polypropylene polymer film which is biaxially oriented and at least
one other layer of a polypropylene polymer film which is uniaxially oriented in a
20 20 transverse direction, the melting point of the uniaxially oriented film being 0.5-10°C
higher than the melting point of the biaxially oriented film, and the total thickness of the
35 35 uniaxially oriented film being 1.2 - 5.0 times greater than the total thickness of the
biaxially oriented film.

40 U.S. Pat. No. 4,393,115 discloses a laminate film having hand-cutting properties
45 25 comprising a biaxially oriented polypropylene layer and a uniaxially oriented
polypropylene layer oriented only in the width direction, laminated with a stretched thin
surface layer of propylene-ethylene block copolymer. The thickness of the uniaxially
oriented layer is in the range between about 1.2 and 5.0 times the thickness of the biaxially
oriented polypropylene layer.

50 30 U.S. Pat. No. 4,414,261 discloses a severable polypropylene adhesive tape having
a base sheet comprising an intermediate layer made of crystalline polypropylene

5 containing from 25 to 35% by weight of a petroleum resin and outer layers made of a crystalline polypropylene laminated on both sides of the intermediate layer, the thickness of the intermediate layer is within a range from 60 to 90% of the base sheet.

10 U.S. Pat. No. 4,447,485 discloses an adhesive tape with finger-tearability and severability comprising a base sheet of a polypropylene resin containing from 5 to 50% by weight of a methylpentene polymer and a subsidiary layer formed on one or both sides of the main layer composed of crystalline polypropylene having a melting point of at least the melting point of the methylpentene polymer, and a bonding layer of a carboxylic acid-modified polypropylene.

15 20 U.S. Pat. No. 5,474,820 discloses a multilayer polypropylene film comprising a base layer of polypropylene and at least one outer layer containing a mixture of HDPE and one or more olefin homopolymers, copolymers or terpolymers and the film has a silk-matte finish. The polypropylene polymer of the base layer has a melting point of at least 140° C and the melt flow index is in the range of 0.5-15 grams/10 minutes.

25 15 **SUMMARY OF THE INVENTION**

30 The present invention provides biaxially oriented substrates comprising isotactic polypropylene compositions. Such biaxially oriented substrates are well suited for use as adhesive tape backings. The tapes and backings of this invention can be severed readily 20 using commercial tape dispensers having metal or plastic cutting teeth to produce cleanly serrated cut edges on the tape. That is, the preferred adhesive tapes and backings 35 described herein have a serrated edge that closely follows the contour of the serrated cutting teeth when tested by the Dispense Test - Metal Blade or the Dispense Test - Plastic Blade described herein.

40 25 In one aspect, the present invention provides an adhesive tape comprising a backing and a layer of adhesive on the backing. The backing comprises a biaxially oriented substrate which comprises an isotactic polypropylene composition.

45 Preferably, the biaxially oriented substrate comprises an isotactic polypropylene composition such that the backing has the following properties taken individually or in any 30 desirable combination:

- 5 A) an elongation to break of from 40% to 170%;
10 B) an energy to sever of up to 350 N-cm/cm² when severed according to
The Dispense Test - Metal Blade;
15 C) an energy to sever of up to 700 N-cm/cm² when severed according to
The Dispense Test - Plastic Blade; and
20 D) an elongation of up to 4% when severed according to either The
Dispense Test - Metal Blade or The Dispense Test - Plastic Blade.

25 The above characteristics are defined with respect to the backing without adhesive
present. It is expected that adhesive has little impact on the characteristics described
30 above.

35 In one preferred embodiment, the biaxially oriented substrate comprises a
polypropylene composition such that the biaxially oriented substrate has the following
40 characteristics taken individually or in any desirable combination:

- 45 A) a weight average molecular weight of at least 100,000 grams/mole;
50 B) a melt flow rate of at least 8 grams/10 minutes, more preferably 12
grams/10 minutes, and most preferably 20 grams/10 minutes;
55 C) a high isotacticity content greater than about 90% as measured by n-
heptane soluble fraction of less than about 15% by weight or having at least 60%
isotactic pentads as determined by ¹³C-NMR analysis; and
60 D) a density preferably of about 0.86-0.92 grams/cm³, more preferably
about 0.88-0.91 grams/cm³.

65 The biaxially oriented substrate is preferably made from a resin comprising an
isotactic polypropylene homopolymer having a melt flow rate greater than 8 grams/10
70 minutes, more preferably greater than 12 grams/10 minutes, and still more preferably
greater than about 20 grams/10 minutes.

75 The resin also preferably has:

- 80 A) a high isotacticity content greater than about 90% as measured by n-heptane
soluble fraction content of less than about 15% by weight or having at least

5 60% isotactic pentads as determined by C-13 nuclear magnetic resonance
 (NMR) analysis;

- 10 5 B) a weight average molecular weight (Mw) of at least 100,000 grams/mole;
 C) a density of 0.86 – 0.92 grams/cm³, preferably 0.88 - 0.91 grams/cm³; and
 D) a melting point temperature of about 160-166° C.

One preferred way to obtain such a resin is to blend:

- 15 10 A) at least one isotactic polypropylene homopolymer "A" having a weight average
 molecular weight of at least 350,000 grams/mole as determined by size
 exclusion chromatography and melt a flow rate of about 0.5-8 grams/10
 minutes, more preferably about 0.5-5 grams/10 minutes; with
 B) at least one isotactic polypropylene homopolymer "B" having a weight average
 molecular weight of at least 100,000 grams/mole as determined by size
 exclusion chromatography and a melt flow rate greater than 8 grams/10
 minutes, and preferably greater than about 20 grams/10 minutes, and more
 preferably greater than about 50 grams/10 minutes. The practical upper
 limit for the melt flow rate of Resin B may be about 350-400 grams/10
 minutes, although the present invention is not so limited. The preferred
 upper limit is about 150 grams/10 minutes. Resin B should have a
 sufficiently high molecular weight to exhibit molecular chain entanglement
 behavior, that is to behave as a solid at ambient temperature and exhibit
 elasticity and melt strength.

35 30 Resins A and B each also preferably have:

- 40 25 A) a high isotacticity content greater than about 90% as measured by n-heptane
 soluble fraction content of less than about 15% by weight or having at least
 60% isotactic pentads as determined by C-13 nuclear magnetic resonance
 (NMR) analysis;
 B) a density of 0.86 – 0.92 grams/cm³, preferably 0.88 - 0.91 grams/cm³; and
 C) a melting point temperature of about 160-166° C.

45 30 Resins A and B can be melt mixed together and formed into a sheet and biaxially
 oriented to produce an adhesive tape backing, or arranged as discrete layers in a multilayer

5 film or some combination of the two and then biaxially oriented to produce an adhesive
tape backing.

10 The biaxially oriented isotactic polypropylene substrate thus formed from the resin
or resins described herein has a melt flow rate greater than about 8 grams/10 minutes and
5 preferably less than about 100 grams/10 minutes, and has improved severability on
commercially available adhesive tape dispensers.

15 The melt flow rates of A and B and the relative amounts of each are selected such
that the backing and the biaxially oriented substrate have the desired properties and
characteristics described herein.

20 Additionally, the resin may be a blend of three or more resins that satisfy the
requirements of A and B stated above.

25 When using a blend, resins A and B may be mixed together in any desirable weight
combinations, preferably with Resin A present in an amount from about 5 to 80 wt%,
more preferably from about 20 to 70 wt%, and with Resin B preferably present in an
15 amount of from 20 to 95 wt%, more preferably from about 30 to 80 wt%.

In one preferred embodiment, the biaxially oriented substrate is a monolayer.

30 In another preferred embodiment, biaxially oriented substrate is of multilayer
construction. In preferred multilayer biaxially oriented substrate comprises discrete layers
each made from a resin meeting the requirements of Resin A or B. Additionally, layers
20 not meeting the requirements of Resins A or B may be included either as the outermost
layers or within a multilayer construction. In such a case, the composite biaxially oriented
substrate preferably has at least 50% of the thickness containing at least 90% isotactic
35 polypropylene. Stated another way, of the layers that together make up the biaxially
oriented substrate, the layers comprising at least 90% isotactic polypropylene account for
40 at least 50% of the total thickness of the biaxially oriented substrate. Preferably, the
multilayer biaxially oriented substrate has a composite melt flow rate of greater than about
45 8 grams/10 minutes, more preferably greater than 12 grams/10 minutes, and most
preferably at least 20 grams/10 minutes. The multilayer biaxially oriented substrate has a
composite melt flow rate of preferably less than about 100 grams/10 minutes.

5 Furthermore, the backing comprising a multilayer biaxially oriented substrate has the
desired severance energy and elongation described herein.

The present invention comprises the desirable adhesive tapes described herein.
10 The present invention also comprises the preferred backings described herein. The present
5 invention also comprises the preferred biaxially oriented substrates described herein, in
which case those characteristics described with respect to the backing apply to the
15 biaxially oriented substrate. Such preferred biaxially oriented substrates may be
monolayer or multilayer, with monolayer being preferred. The present invention also
comprises the preferred resins and blends described herein which may be oriented to
10 provide the preferred biaxially oriented substrates and/or backings described herein.

20 Certain terms are used in the description and the claims that, while for the most
part are well known, may require some explanation. "Area stretch ratio," as used herein,
indicates the ratio of the area of a given portion of a stretched film to the area of the same
25 portion prior to stretching. For example, in a biaxially stretched film having an area
15 stretch ratio of 36:1, a given 1 cm² portion of unstretched film would have an area of 36
cm² after stretch.

30 "Biaxially oriented," when used herein to describe a film, indicates that the film
has been stretched in two different directions in the plane of the film. Typically, but not
always, the two directions are perpendicular. Biaxially oriented films may be sequentially
20 stretched, simultaneously stretched, or stretched by some combination of simultaneous and
sequential stretching. "Simultaneously biaxially oriented," when used herein to describe a
35 film, indicates that significant portions of the stretching in each of the two directions are
performed simultaneously.

40 Molecular weight and molecular weight distribution affect polymer process and
45 mechanical properties. Polymer molecular weight is typically expressed as a weight
25 average molecular weight. Typically, the molecular weight of commercially available
average molecular weight. Typically, the molecular weight of commercially available
polyolefin resins is estimated by measuring the melt flow rate ("MFR"), which increases
isotactic polypropylene resins for use in biaxial orientation equipment typically have a
45 with decreasing molecular weight and hence melt viscosity. Commercial film grade
isotactic polypropylene resins for use in biaxial orientation equipment typically have a
30 MFR in the range from about 1-6 grams/10 minutes. At very high MFR values, biaxial

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5 orientation of polypropylene resins becomes increasingly difficult because of a lack of
melt strength at useful commercial equipment speeds during the stretching operation.

10 Unless specified otherwise, all values of melt flow rate of inventive resins and
films described herein are provided in units of grams/10 minutes measured according to
5 ASTM D 1238-95, Flow Rates of Thermoplastics by Extrusion Plastometer, Procedure B,
Condition 230/2.16.

15 The molecular weight distribution is often characterized by the polydispersity
index which typically is the ratio of the weight average molecular weight to the number
average molecular weight. The polydispersity index affects processability of
10 polypropylene resins and also the mechanical properties of the resultant biaxially oriented
film. The polydispersity index can be determined by measuring the dynamic shear
20 properties of the polypropylene melt (see Proceedings of the 2d World Congress of
Chemical Engineering, Montreal, vol. 6, pp. 333-337 (1981)). Preferably, the films of this
25 invention have polydispersity index values between about 2 and 8, more preferably
15 between about 2.5 and 7.

30 A minimum molecular weight or chain length is required to develop strength in
uncrosslinked polymers. The minimum chain length is called the critical chain
35 entanglement molecular weight (M_c) and defines the chain length required for the onset of
chain entanglements. Chain entanglements provide topological constraints to chain
40 motion, and allow the polymer to behave like a crosslinked network and bear stress; this
ability is sometimes known as green strength or web strength. Below the M_c ,
45 uncrosslinked polymer systems have no such constraints and therefore lack elasticity and
undergo chain slippage and large scale stress relaxation.

50 For many polymers, M_c is taken as the inflection point observed for polymers in
plots of viscosity against increasing molecular weight ("Viscoelastic Properties of
55 Polymers," 3rd ed., J.D. Ferry, p. 242, John Wiley & Sons, NY (1980)). For molecular
weights below M_c , polymer viscosity increases with the first power of molecular weight,
45 that is, the viscosity and molecular weight increase monotonically. With decreasing chain
length below M_c the polymer behaves first like a wax and finally as a viscous liquid.
50 Above M_c , however, the polymer behaves as a viscoelastic solid and viscosity increases
with molecular weight to the 3.4 power; this much greater dependence of viscosity on

5 molecular weight is explained as the effect of entanglements in constraining chain motions
and increasing viscosity. Mc can therefore be interpreted as the transition between wax
behavior and polymer behavior.

10 It is often desirable to provide very clear plastic film for use in clear adhesive
5 tapes, packaging, and other applications. The adhesive tape backings herein described in
this invention exhibit good clarity and low haze. The biaxially oriented polypropylene
15 film of the present invention displays reduced haze in transmission compared to films
which do not meet the requirements of this invention. The oriented films of the present
invention preferably are optically clear to the unaided eye under typical interior lighting
10 conditions. More preferably, the films have a haze of less than 5% as measured by ASTM
20 D1003-95.

25 **BRIEF DESCRIPTION OF THE DRAWINGS**

30 The present invention will be further explained with reference to the appended
15 Figures, wherein like structure is referred to by like numerals throughout the several
views, and wherein:

35 Figure 1 is an isometric view of a length of tape according to the present invention;

40 Figure 2 is a side view of a roll of adhesive tape according to the present invention;

45 Figure 3 is a side view of a roll of tape on a dispenser according to the present
invention;

50 Figure 4 is an isometric view of a test fixture used to test the severing
characteristics of film according to the present invention;

55 Figure 5 is an isometric view of the metal dispenser blade useful in the tape
dispenser of Figure 3 and the test fixture of Figure 4;

Figure 6 is a side view of the metal dispenser blade of Figure 5;

Figure 7 is a view of a plastic dispenser blade taken in direction 7-7 of Figure 3;

Figure 8 is a cross-sectional view of the dispenser blade of Figure 7 taken along
line 8-8 of Figure 7;

Figure 9 is a top view of the dispenser blade of Figure 7 taken in direction 9-9;

5 Figure 10 is a side view of a portion of the apparatus of Figure 4 and the metal
dispenser blade of Figure 5;

10 Figure 11 is a side view of a portion of the apparatus of Figure 4 and the plastic
dispenser blade of Figure 8; and

15 5 Figure 12 is an illustration of a typical severance or dispense testing curve for a
polypropylene tape backing of the present invention.

20 DETAILED DESCRIPTION OF THE INVENTION

25 Referring to Figure 1, there is shown a length of tape 10 according to one preferred
embodiment of the present invention. Tape 10 comprises a film backing 11 and a layer of
10 adhesive 18. Backing 11 includes a biaxially oriented substrate 12. The biaxially oriented
substrate may be a monolayer or a multilayer film. Biaxially oriented substrate 12
20 includes first major surface 14 and second major surface 16. Preferably, backing 11 has a
thickness in the range of about 0.002 to about 0.005 centimeters. Biaxially oriented
substrate 12 is coated on first major surface 14 with a layer of adhesive 18. Adhesive 18
25 15 may be any suitable adhesive as is known in the art. Backing 11 may include an optional
release or low adhesion backsize layer 20 coated on the second major surface 16 of the
biaxially oriented substrate 12 as is known in the art. In one preferred embodiment,
30 biaxially oriented substrate 12 comprises a biaxially oriented monolayer polypropylene
film as described herein. Backing 12 alternatively may comprise a multilayer backing, at
35 20 least one of which layers comprises a biaxially oriented polypropylene film as described
herein.

40 35 Biaxially oriented substrate 12 includes those portions of the backing 11 that were
biaxially oriented. Biaxially oriented substrate 12 may comprise a monolayer film or a
multilayer or laminated film. Preferably, biaxially oriented substrate 12 comprises a
45 25 monolayer film. Backing 11 may include optional coatings 20 that are applied to biaxially
oriented substrate 12. Such coatings may comprise, for example, a low adhesive backsize
coating, a coating which accepts writing or printing, a coating that provides a matte finish,
or the like. Tape 10 thus comprises a backing 11 and adhesive 18. The backing 11
comprises biaxially oriented substrate 12 and optional coatings 20, if present.

5 Preferably, the biaxially oriented substrate 12 comprises an isotactic polypropylene composition such that the backing 11 has the following properties taken individually or in any desirable combination:

- 10 A) an elongation to break of from 40% to 170%;
5 B) an energy to sever of up to 350 N-cm/cm² when severed according to The Dispense Test - Metal Blade;
15 C) an energy to sever of up to 700 N-cm/cm² when severed according to The Dispense Test - Plastic Blade; and
D) an elongation of up to 4% when severed according to either The Dispense Test
20 - Metal Blade or The Dispense Test - Plastic Blade.

25 The above characteristics are defined with respect to the backing 11 without adhesive 18 present. It is expected that adhesive 18 has little impact on the characteristics described above.

30 In one preferred embodiment, the biaxially oriented substrate 12 comprises a
35 polypropylene composition such that the biaxially oriented substrate has the following
40 characteristics taken individually or in any desirable combination:

- 30 A) a weight average molecular weight of at least 100,000 grams/mole;
B) a melt flow rate of at least 8 grams/10 minutes, more preferably 12 grams/10
minutes, and most preferably 20 grams/10 minutes;
35 C) a high isotacticity content greater than about 90% as measured by n-heptane
40 soluble fraction of less than about 15% by weight or having at least 60% isotactic pentads
as determined by ¹³C-NMR analysis; and
D) a density preferably of about 0.86-0.92 grams/cm³, more preferably about 0.88-
0.91 grams/cm³.

45 The biaxially oriented substrate 12 is preferably made from a resin comprising an
isotactic polypropylene homopolymer having a melt flow rate greater than 8 grams/10
minutes, more preferably greater than 12 grams/10 minutes, and still more preferably
greater than about 20 grams/10 minutes.

50 The resin also preferably has:

- 5 A) a high isotacticity content greater than about 90% as measured by n-heptane
soluble fraction content of less than about 15% by weight or having at least
60% isotactic pentads as determined by C-13 nuclear magnetic resonance
(NMR) analysis;
- 10 5 B) a weight average molecular weight (Mw) of at least 100,000 grams/mole;
C) a density of 0.86 – 0.92 grams/cm³, preferably 0.88 - 0.91 grams/cm³; and
D) a melting point temperature of about 160-166° C.

15 One preferred way to obtain such a resin is to blend:

- 10 10 A) at least one isotactic polypropylene homopolymer "A" having a weight average
molecular weight of at least 350,000 grams/mole as determined by size
exclusion chromatography and melt a flow rate of about 0.5-8 grams/10
minutes, more preferably about 0.5-5 grams/10 minutes; with
- 20 15 B) at least one isotactic polypropylene homopolymer "B" having a weight average
molecular weight of at least 100,000 grams/mole as determined by size
exclusion chromatography and a melt flow rate greater than 8 grams/10
minutes, and preferably greater than about 20 grams/10 minutes, and more
preferably greater than about 50 grams/10 minutes. The practical upper
30 20 limit for the melt flow rate of Resin B may be about 350–400 grams/10
minutes, although the present invention is not so limited. The preferred
upper limit is about 150 grams/10 minutes. Resin B should have a
sufficiently high molecular weight to exhibit molecular chain entanglement
35 25 behavior, that is to behave as a solid at ambient temperature and exhibit
elasticity and melt strength.

Resins A and B each also preferably have:

- 40 25 A) a high isotacticity content greater than about 90% as measured by n-heptane
soluble fraction content of less than about 15% by weight or having at least
60% isotactic pentads as determined by C-13 nuclear magnetic resonance
(NMR) analysis;
- 45 30 B) a density of 0.86 – 0.92 grams/cm³, preferably 0.88 - 0.91 grams/cm³; and
C) a melting point temperature of about 160-166° C.

5 Resins A and B can be melt mixed together and formed into a sheet and biaxially
10 oriented to produce an adhesive tape backing, or arranged as discrete layers in a multilayer
film or some combination of the two and then biaxially oriented to produce an adhesive
tape backing.

15 5 The biaxially oriented isotactic polypropylene substrate 12 thus formed from the
resin or resins described herein has a melt flow rate greater than about 8 grams/10 minutes
15 and preferably less than about 100 grams/10 minutes, and has improved severability on
commercially available adhesive tape dispensers.

20 10 The melt flow rates of A and B and the relative amounts of each are selected such
that the backing and the biaxially oriented substrate have the desired properties and
20 characteristics described herein.

25 Additionally, the resin may be a blend of three or more resins that satisfy the
30 requirements of A and B stated above.

35 25 When using a blend, resins A and B may be mixed together by any of the well
known plasticating shear mixing equipment such as extrusion mixing in any desirable
40 weight combinations, preferably with Resin A present in an amount from about 5 to 80
45 wt%, more preferably from about 20 to 70 wt%, and with Resin B preferably present in an
amount of from 20 to 95 wt%, more preferably from about 30 to 80 wt%. At weight
compositions with Resin B in excess of about 80% the material may become difficult to
50 process, however, the actual limit in composition is determined by the particular process
and equipment employed and therefore depends on strain rate during stretching,
temperature profiles, magnitude of stretching and the like.

55 40 When using a blend, the resin blends may be prepared by any known mixing
45 operation, but preferably are prepared by extrusion mixing of dry components prior to film
stretching or separately to produce pellets for later use.

50 45 Although processability may be simplified by biaxially orienting a single layer to
produce film, this invention is not so limited. A plurality of layers may be incorporated in
55 the biaxially oriented substrate 12. For example, rather than blending resins A and B and
extruding a monolayer film, a multilayer film may be laminated or coextruded comprising
discrete layers each made from a resin meeting the requirements of Resin A or B.

5 Additionally, layers not meeting the requirements of Resins A or B may be included either
as the outermost layers or within a multilayer construction. In such a case, the composite
biaxially oriented substrate 12 has at least 50% of the thickness containing at least 90%
isotactic polypropylene. Stated another way, of the layers that together make up the
10 biaxially oriented substrate 12, the layers comprising at least 90% isotactic polypropylene
account for at least 50% of the total thickness of the biaxially oriented substrate 12.
15 Additionally, the multilayer biaxially oriented substrate 12 has a composite melt flow rate
of greater than about 8 grams/10 minutes, more preferably greater than 12 grams/10
minutes, and most preferably at least 20 grams/10 minutes. The multilayer biaxially
20 oriented substrate 12 has a composite melt flow rate of preferably less than about 100
grams/10 minutes. Furthermore, the backing 11 has the desired severance energy and
elongation described herein.

25 Further, it is anticipated that resins, or blends of two or more resins, at least one of
which initially have a melt flow rate below 8 grams/10 minutes, could be used if the
15 polypropylene is subsequently degraded or oxidized to MFR values of about 8 grams/10
minutes or higher, preferably up to 150 grams/10 minutes.

30 It is well known that, in film processing, edge trim is often recycled to the
extrusion process, either with or without pelletizing. In this regard, if the edge trim is
below 8 MFR it may be considered as additional Resin A as described above and if it is
20 above 8 MFR it may be considered as additional Resin B as described above. Preferably,
edge trim would be above 8 MFR and below 150 MFR and considered as additional Resin
35 B.

40 The polydispersity index is preferred to be between about 2 and 8, more preferably
between about 2.5 and 7.5 as measured according to ASTM D 4065-95. Typically, low
25 polydispersity index polypropylene resins are difficult to process on commercial biaxial
orientation equipment, although it is anticipated that using such resins may reduce the
severing energy of the biaxially oriented substrate. A high polydispersity index or broad
45 molecular weight distribution resin may be easier to process, but is anticipated to promote
higher severing energy. Thus, a balancing of molecular weight or MFR and the molecular
30 weight distribution may be desirable in application of the present invention

5 The compositions meeting the characteristics described herein are preferably
homopolymers. When the resins are referred to herein, including the claims, as a
homopolymer, this also includes resins having therein co-polymer in an amount small
enough that the desired characteristics and properties of the resin and film are still met.

10 5 In film processing, polymer resins are subjected to high shearing stresses at high
temperature. In a typical industrial extrusion system, polypropylene molecular weight
degrades somewhat due to chain scission. During processing, the longest polymer
molecules are degraded to a larger degree than the shorter molecules. Therefore, for a
given resin the film molecular weight may be lower than the resin molecular weight.

15 10 The polypropylene composition can be cast into sheet form as is known in the art,
to prepare a sheet suitable for stretching to arrive at the preferred biaxially oriented
substrate 12 described herein. One suitable method to cast a sheet is to feed the resin into
the feed hopper of a 4.45 cm single screw extruder manufactured by H.P.M. (of Mt.
20 25 Gilead, OH) having an extruder barrel temperature adjusted to produce a stable
homogeneous melt. The polypropylene melt can be extruded through a 17.8 cm single
manifold sheet die onto a rotating water cooled steel casting wheel having 50-60° C water
30 35 circulating through it. The cast sheet can be quenched by passing through a water bath
maintained at about 30°C to produce a cast sheet having a thickness of about 0.12-0.16
cm.

20 20 The sheet is then biaxially oriented to provide biaxially oriented substrate 12
having the desired characteristics and properties described herein.

25 25 The preferred properties described herein may be obtained by any suitable method
and apparatus for biaxially orienting the biaxially oriented substrate 12. Of all stretching
methods, the methods most preferred for commercial manufacture of films for tape
40 45 backings include biaxial stretching by mechanical tenter such as the methods and
apparatus disclosed in U.S. Patent Nos. 4,330,499 and 4,595,738, and more preferably by
the methods and tenter apparatus for simultaneous biaxial stretch disclosed in U.S. Patent
Nos. 4,675,582; 4,825,111; 4,853,602; 5,036,262; 5,051,225; and 5,072,493. Although
50 55 biaxially stretched films can be made by tubular blown film or flat film tenter stretching
processes, it is preferable that the films of this invention, when used as tape backings, be

5 made by a flat film tenter stretching process to avoid thickness variations and processing difficulties typically associated with tubular blown film processes.

10 Flat film tenter stretching can be accomplished by sequential or simultaneous stretching processes. The simultaneous process surprisingly permits for the incorporation 5 of greater levels of resin B which in turn impart more desirable properties including improved severability and clarity. An additional advantage of such a process is that the 15 film surfaces do not contact stretching rollers as in the case of commercially available sequential film stretching lines, which preserves the film surface from defects caused by 20 roller contact. In addition, other defects like thickness variability, die lip instabilities, hardbands and the like are minimized in comparison to tubular or blown film stretching processes.

25 The polypropylene composition is selected to allow biaxial stretch to an area 15 stretch ratio of at least 36:1. The polypropylene composition also preferably allows 30 stretch to occur at a line speed of at least 30 meters/minute.

35 The biaxially oriented substrates 12 useful in this invention, when used as a 25 backing 11 for a tape 10, preferably have a final thickness between about 0.002-0.005 cm. 30 Variability in film thickness is preferably less than about 5%. Thicker and thinner films 40 may be used, with the understanding that the film should be thick enough to avoid excessive flimsiness and difficulty in handling, while not being so thick so as to be 45 undesirably rigid or stiff and difficult to handle or use.

50 Backing 11 may optionally include additives and other components as is known in 35 the art, preferably in an amount selected so as not to adversely affect the tensile and dispense properties attained by the preferred embodiments described herein. For example, 40 the films of the present invention may contain fillers, plasticizers, colorants, lubricants, processing aids, nucleating agents, ultraviolet-light stabilizing agents, and other additives. Typically such materials are added to a polymer before it is made into an oriented film (e.g., in the polymer melt before extrusion into a film). Organic fillers may include 45 organic dyes and resins, as well as organic fibers such as nylon and polyimide fibers. Inorganic fillers may include pigments, fumed silica, calcium carbonate, talc, 50 diatomaceous earth, titanium dioxide, carbon fibers, carbon black, glass beads, glass bubbles, mineral fibers, clay particles, metal particles and the like. Other additives such as

5 flame retardants, stabilizers, antioxidants, compatibilizers, antimicrobial agents (e.g., zinc oxide), electrical conductors, and thermal conductors (e.g., aluminum oxide, boron nitride, aluminum nitride, and nickel particles) can be blended into the polymer used to form the
10 film.

5 The adhesive 18 may be any suitable adhesive as is known in the art. Preferred
adhesives are those activatable by pressure, heat or combinations thereof. Suitable
15 adhesives include those based on acrylate, rubber resin, epoxies, urethanes or
combinations thereof. The adhesive 18 may be applied by solution, water-based or hot-
melt coating methods. The adhesive may be applied in any desired amount, and typically
10 is applied to provide a conventional dry coating weight between about 0.0015 to 0.005
20 grams/cm².

25 The backing 11 may be optionally treated by exposure to flame or corona
discharge or other surface treatments including chemical priming to improve adhesion of
subsequent coating layers. In addition, the second surface 16 may be coated with optional
25 low adhesion backsize materials 20 to restrict adhesion between the opposite surface
adhesive layer 18 and the backing 11, thereby allowing for production of adhesive tape
rolls capable of easy unwinding, as is well known in the adhesive coated tape-making art.

30 Such a tape 10 is particularly well-suited for light duty home and office use or for
other uses like die-cut tapes or other die-cut substrates.

35 20 In one preferred embodiment, tape 10 is provided in the form of a spirally wound
roll 22 wound up in direction R and optionally on a core 24 as illustrated in Figure 2.
Such rolls can be provided on a table top or hand held dispenser 26 as illustrated in Figure
40 3. The dispensers can include a metal cutting blade or plastic cutting blade. Preferred
dispensers include those available as SCOTCH brand Cat. 15 or Cat. 40 tabletop tape
45 25 dispenser equipped with metal cutting blades, SCOTCH brand Cat. 25 or Cat. H-125/126
plastic two-piece plastic dispensers equipped with metal cutting blades, and SCOTCH
brand Cat. 104 or Cat. 105 injection-molded polystyrene dispensers with plastic cutting
blades, all available from Minnesota Mining and Manufacturing Company, St. Paul,
Minnesota.

5 The details of converting film backings into tapes is well within the skill of those
in the art, and need not be described in any greater detail herein. See, for example, U.S.
Patent No. 4,451,533, "Disposable Polypropylene Adhesive-Coated Tape," (Wong et al).

10 The operation of the present invention will be further described with regard to the
5 following detailed examples. These examples are offered to further illustrate the various
specific and preferred embodiments and techniques. It should be understood, however,
that many variations and modifications may be made while remaining within the scope of
15 the present invention.

Test Methods

10 **Tensile Properties:**

20 **ASTM D-882-95A, Tensile Properties of Thin Plastic Sheeting, Method A**

25 The tensile elongation-at-break of backings was measured by the procedures
described in ASTM D-882-95A, "Tensile Properties of Thin Plastic Sheeting," Method A.
The backings were conditioned for 24 hours at 25° C and 50% relative humidity. The tests
25 15 were performed using a tensile-testing machine commercially available as a Model 400/S,
from MTS Systems Corporation, Eden Prairie, MN. Specimens for this test were 1.91 cm
wide and 15 cm in length. An initial jaw separation of 10.2 cm and a crosshead speed of
30 30 30 cm/min were used. Specimens were tested for each sample in the reference direction of
the film. Results are reported in Table 2 below. The elongation-to-break values are
30 20 reported for the reference direction based on the initial gauge length of the sample. As
used herein, including the claims, the term "tensile elongation to break" is used to describe
35 results obtained by the just-described method.

40 **Melt Flow Rate: ASTM D 1238-95, Flow Rates of Thermoplastics by Extrusion**

40 25 **Plastometer**

45 The melt flow rate of the resins and backing samples were measured using the
procedures described in ASTM D 1238-95, Flow Rates of Thermoplastics by Extrusion
Plastometer, Procedure B, Condition 230/2.16. A Tinius-Olsen Extrusion Plastometer
Model U-E-4-78, Willow Grove, PA., equipped with a mechanically actuated timer was
30 30 used. A one-inch piston arm travel distance was used for all samples. Samples were

5 charged into the heated plastometer and the residence time prior to measurement was kept at 7.0 ± 0.5 minutes. When films are tested, the film sample is rolled up and introduced into the apparatus.

10 5 Weight Average Molecular Weight (Mw):

ASTM D 5296-92, Molecular Weight Averages by Size Exclusion Chromatography (SEC)

15 The weight average molecular weights (Mw) were measured using ASTM D 5296-92, Molecular Weight Averages by Size Exclusion Chromatography (SEC). A Waters 150C chromatograph (Waters Corporation, Milford, Massachusetts) equipped with a two-column set (Jordi Associates mixed bed with 500 angstrom pore size) was used. Samples 10 were in the form of pellet, cast sheet, or stretched film.

20 25 10.0 ml of 1,2,4-trichlorobenzene (TCB) containing 0.1% Ionol (antioxidant) and Phosphite 168 (high temperature stabilizer) were added to approximately 25 mg of sample and dissolved by heating at 160° C for 12.0 hrs. The solutions were then filtered using the internal filtration system (0.5 micrometer) of the Waters 150C instrument, and 150 30 35 microliters of each solution were injected into the chromatograph operating at a temperature of 140° C and an eluent (TCB) rate of 1.0 ml/min. Concentration changes were measured using an internal refractive index detector. The weight average molecular weights (Mw) were calculated using a Dell computer equipped with Polymer Labs PL Caliber software, based on a calibration made of narrow dispersity polystyrene standards ranging in Mw from 6.30×10^6 to 800 grams/mole.

ASTM D 4065-95, Polydispersity Index by Measurement of Dynamic Mechanical Properties of Plastics

40 45 25 The polydispersity index of both polypropylene composition and film was measured according to ASTM D 4065-95, using a Rheometrics Dynamic Mechanical Spectrometer (Rheometrics Scientific Incorporated, Piscataway, New Jersey) oscillating disc rheometer. Sample film or resin was placed between two 25 mm diameter parallel plates with a gap of about 1-3 mm in an oven at 200°C, and subjected to an oscillatory 30 strain sweep in the frequency range of 0.1 to 400 radians per second. The dynamic stress response was measured and values of the storage modulus G' and loss modulus G"

5 calculated. The point where these modulii have co-incident values is the crossover point, and the value of dynamic modulus at this point is G_c, in dyne/cm². The polydispersity index is calculated as PI = 10⁶/G_c.

10

5 ASTM D 1003-95, Transmittance Haze

15 The transmittance haze of inventive film was measured using a Haze-guard Plus transmission and haze meter (BYK-Gardiner, Silver Springs, MD.) according to the procedure described in ASTM D 1003-95.

20

10 Severance Properties: Dispense Testing of Films

25 Test specimens 1.91 cm wide and 15 cm long were slit from uncoated sample films using a razor blade cutter equipped with new blades. Test specimens were conditioned for 24 hours at 25° C and 50% relative humidity prior to testing.

25

15 The test fixture used to measure severability is shown in Figure 4. The test fixture comprised a commercially available tape dispenser 100M (Scotch™ Cat. H-127 two-piece polystyrene molded dispenser equipped with a metal cutting blade, available as of the filing date hereof from Minnesota Mining & Manufacturing Co., St. Paul, MN) or commercially available tape dispenser 100P (Scotch™ Cat. 122 two-piece molded polystyrene dispenser equipped with a plastic cutting blade, available as of the filing date hereof from Minnesota Mining & Manufacturing Co., St. Paul, MN) mounted to a 15.2 cm x 15.2 cm x 1.1 cm aluminum rear mounting plate 102. The dispenser was restricted from flexing during the severing test by being placed between the rear mounting plate 102 and a 0.3 cm thick aluminum front mounting plate 104 milled to the contour of the test dispenser 100P or 100M. The test dispenser was firmly held in place between the front 104 and rear 25 102 mounting plates by a threaded thumbscrew 106. The rear mounting plate 102 was affixed to a 2.4 cm diameter cylindrical base mounting stud 108 by machine screws 110. The base mounting stud 108 was milled to include a 90° angle cut-out so that the rear 30 mounting plate 102 was held in the vertical centerline of the tensile testing machine, that is, the angle between the axis of the rear mounting plate 102 and test dispenser 100P or 35 40 45

50

55

5 100M was 0° with respect to the machine centerline. The base stud 108 was affixed to the testing machine deck by locking pins inserted into drillouts 109 in the base stud.

10 The test dispenser 100M or 100P was mounted onto the rear mounting plate 102 by inserting the dispenser hub over an aluminum hub mounting shaft 112 which is screwed
5 into the rear mounting plate 102. The bottom of the dispenser rested against seat 115 which prevented rotation of the dispenser during testing. The test dispenser was mounted so that the row of teeth of the dispenser cutting blade was perpendicular to the machine centerline. In this way, the film being tested was loaded substantially uniformly across its width when severed.

15 Dispenser 100M included a steel serrated cutting blade 120 illustrated in Figures 5 and 6. Steel cutting blade 120 was formed of about 0.05 cm thick nickel plated steel and included a rectangular land portion 122 at least as wide as the film 12 and about 0.3 cm long in the direction corresponding to the reference direction R of the film 12 extending across the blade. The land portion 122 defines a generally planar surface to which the test sample is temporarily secured. Blade 120 also included a blade support portion 126 at the rear edge of the land portion 122, with the land portion forming an angle β of 80° with the support 126. Blade support 126 is about 1.32 cm long. Blade 120 further included a generally U-shaped portion 128 at the edge of the land portion opposite the support portion which has a row of teeth 130 along its distal edge. Each tooth 130 is generally triangular, has a tip in or slightly lower than the plane of the land 122 and spaced from the tips of adjacent teeth 130 by about 0.12 cm, is defined by a height of about 0.06 cm, a sharpness defined by a radius of curvature of about 0.003 cm, and the apex 132 of said teeth 130 form an included angle of 60°. The teeth 130 project outward from the plane of the blade support portion 126 at an angle α of about 50°. The sides of the generally U-shaped portion 128 are at an angle γ to one another of 72°.

20 Dispenser 100P includes an injection-molded polystyrene blade 140 illustrated in Figures 7-9. Polystyrene blade 140 on dispenser 100P is integrally molded with one of the two halves of the tape dispenser 100P. Blade 140 is formed by filling the cavities of a steel mold using a typical injection molding process. As seen in Figures 8 and 9, blade
25 30 140 includes a land surface 144 which is about 0.35 cm wide. Land surface 144 is slightly convex, having a radius of curvature of 2.54 cm. Forward of land 144 is a V-shaped

35 40

5 portion formed by surfaces 148 and 149 which meet at an inside angle δ of 125°. Surface
148 of the V-groove makes an angle of v with the linear approximation of land 144 of 70°.
A series of ridges 154 extend from the front of the dispenser. The ridges 154 are each
10 formed by sides 154a and 154b which meet at ridge 154c. Each tooth peak 150 is formed
by the intersection of surface 149 with the ridges 154. As best seen in Figures 7 and 9,
5 each tooth is thereby formed by the intersection of three planes: sides 154a and 154b of
ridge 154, and surface 149 of the V-shaped groove. As seen in Figure 9, sides 154a and
15
154b meet an at included angle θ of 74°. As seen in Figure 8, surface 149 forms an angle
 ϕ of 50° with edge 154c of ridge 154. Each tooth 150 has a tip in or slightly lower than
10 the plane of the land surface 144 and is spaced from the tips of adjacent teeth 150 by about
0.127 cm. Each tooth has a height of about 0.020 cm, measured as the height H from the
20 peak of the tooth to the adjoining valleys between teeth. Each tooth has an edge sharpness
having a radius of curvature of about 0.010 cm.

25 In either test dispenser, a piece of double-coated adhesive tape (Scotch™ Cat. 665)
25 was applied to land area 122 or 144 and the test specimen was adhered firmly to the
adhesive surface of the double-coated tape with finger pressure to prevent forward motion
during severance testing.

30 The test specimen was aligned at an angle of 0° to the machine centerline so that
the force of the dispenser was substantially evenly distributed across the width of the
20 sample. The dispenser 100M or 100P was oriented such that the tips of the cutting blade
120 or 140 were directly under the jaws 162. For tests using the dispenser 100M with
35 metal dispenser 120, the dispenser was oriented at an angle such that the land 122 was at
an angle σ_1 of 110° relative to the vertical direction of travel A of the tester (see Figure 10,
which illustrates only the cutter blade 120 relative to the jaws 162, with the rest of the
40 dispenser and test fixture removed for illustrative purposes only). For tests using the
dispenser 100P with plastic blade 140, the dispenser was oriented at an angle such that the
edge 154c of ridge 154 was at an angle σ_2 of 32° relative to the vertical direction of travel
45 A of the tester (see Figure 11, which illustrates only the cutter blade 140 relative to the
jaws 162, with the rest of the dispenser and test fixture removed for illustrative purposes
only).

50

5 The free end of the test specimen was then gripped in the upper jaws 162 of the tensile testing machine so that the distance between the upper jaws and the cutting blade 120 or 140 was 10.2 cm. The specimen was loaded with no tension so that the cutting blade did not contact the specimen prior to the start of the test. The upper jaws were
10 5 attached to the machine crosshead which traveled on support rails 14. The test specimen was next pre-loaded in tension to a value of 0.9 N to make contact with the cutting blade 120 or 140. The backing 11 was then pulled in direction A by the jaws 162 at a rate of 30 cm/minute. The load and elongation of the specimen were measured and recorded, and
15 10 the energy to sever was calculated from the area under the load/elongation, as illustrated in Figure 12, and reported in Table 1. In Figure 12, the load is indicated along the vertical axis, with the elongation indicated on the horizontal axis. The load and elongation
20 15 increase along portion 200 of the curve, until the peak load 202 is reached, where the elongation is indicated by 204. The load then decreases as the elongation continues along portion 206 of the curve. As reported herein, the energy is calculated for that portion of
25 15 the curve from zero elongation to the elongation 204 at maximum load 202. It is believed that the teeth of the dispenser puncture the film at about the point of maximum load 202, at which time the load decreases as the punctures through the film propagate to complete severance.

30 As used herein, including the claims, the term "The Dispense Test - Metal Blade"
35 20 refers to the just described test using dispenser 100M, and the term "The Dispense Test - Plastic Blade" refers to the just described test using dispenser 100P.

35 Preparation of Examples

40 25 Preparation of Resin Master Batches

45 Sample resin master batches with a weight composition of low melt flow resin A and high melt flow resin B of 50:50 were prepared for making the biaxially oriented substrate Examples as follows. First, 50 wt% of FINA 3374 isotactic polypropylene homopolymer resin was compounded with 50 wt% of each of the three following resins:
50 30 FINA 3860 polypropylene (resulting in Master Batch X); FINA 3892 polypropylene

(resulting in Master Batch Y); or FINA 98035 polypropylene (resulting in Master Batch Z); all supplied by FINA Oil & Chemical Co., Dallas, TX. The polypropylene master batches were mixed by feeding the separate polypropylene resins into a 50-mm twin screw extruder using a K-Tron T-35 volumetric feeder. The extruder was a 50 mm 10:1 L/D co-rotating Baker-Perkins twin screw. A 5-hole stranding die was mounted on the extruder and the extrude strands were fed into a water bath prior to pelletizing. The extruder was operated at a rate of 48.5 lbs./hour at a speed of 275 rpm and a die temperature of 232° C. The final weight composition and melt flow rate were obtained by addition of neat homopolymer resin to the master batch resin to achieve the desired weight percentages reported in Table 1 below.

Table 1: Weight Ratios of Polypropylene Resins

Example	Neat Isotactic PP Resins				Master Batch Resins		
	3374	3860	3982	98035	X	Y	Z
1	100	-	-	-	-	-	-
2	80	-	-	-	20	-	-
3	60	-	-	-	40	-	-
4	40	-	-	-	60	-	-
5	100	-	-	-	-	-	-
6	40	-	-	-	60	-	-
7	20	-	-	-	80	-	-
8	100	-	-	-	-	-	-
9	40	-	-	-	60	-	-
10	100	-	-	-	-	-	-
11	50	-	-	-	50	-	-
12	-	50	-	-	50	-	-
13	-	100	-	-	-	-	-
14	50	-	-	-	-	50	-
15	-	-	50	-	-	50	-
16	-	-	-	50	-	-	50

Examples 1-4

The appropriate resin mixture was fed into the feed hopper of a 4.45 cm single screw extruder manufactured from H.P.M (Mt. Gilead, OH) having an extruder barrel temperature adjusted to produce a stable homogeneous melt of about 250-260°C. The polypropylene melt was extruded through a 17.8 cm single manifold sheet die onto a rotating water cooled steel casting wheel which had about 50-60° C water circulating

5 through it. The cast sheet was next passed through a quenching water bath maintained at about 30°C to produce a cast sheet having a thickness of about 0.16 cm.

10 Sequentially biaxially oriented polypropylene biaxially oriented substrates were prepared by a process known as the sequential tenter process. The cast sheet was passed over a first series of heating rolls maintained internally from about 127°C to 136°C, and then stretched between two nipped drawing rolls rotating at different speeds to attain a first draw ratio of 5.0:1 in extrusion or casting direction. The uniaxially stretched sheet was then fed into a tenter oven with multiple heat zones having temperatures ranging from 15

15 158° to 175° C and stretched or oriented between two tenter rails in the direction perpendicular to the first stretching at a draw ratio of about 9:1. The resulting film had a thickness of about 0.003-0.0035 cm and was cooled in air and annealed on an annealing drum with an internal temperature of 120°C. The edges were subsequently razor slit and the film wound onto a master roll. The film was slit into useful sample widths using a 20

20 razor blade cutter equipped with fresh blades.

25 15

Examples 5-7

30 Simultaneously biaxially oriented polypropylene Examples 5-7 were prepared by a process known as the simultaneous tenter process. First, the appropriate resin mixture was extruded to produce a stable homogeneous melt having a melt temperature of about 25

20 257°C. The polypropylene melt was cast onto a water cooled steel casting wheel rotating at about 10 meters per minute which had about 11° C water circulating through it. The 35 cast sheet was next passed through a quenching water bath maintained at about 20°C to produce a cast sheet having a thickness of about 0.15-0.2 cm.

40 The cast film was simultaneous stretched in longitudinal and transverse directions 25 using a diverging spindle simultaneous biaxial orienting tenter equipped with 7:1 stretching spindles, at a line speed of 80-85 meters per minute and a stretching temperature of about 175-180° C to a final balanced area stretching ratio of about 50:1.

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Examples 8-16

Examples 8-16 were cast as described above in Examples 1-4.

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Examples 8-9 were simultaneously stretched in two perpendicular directions using a laboratory two-way film stretching machine known as a frame or batch stretcher as follows. The cast film sheet of 0.16 cm thickness was cut into square tablets of 6.83 cm on a side and held in the stretching oven of the batch stretcher by edgewise gripping with a series of clips to leave a stretchable sample of 5.08 cm on a side. The tablet was pre-heated for 90 seconds at 155° C, and stretched at a rate of about 300%/second in the reference direction and about 250%/second in the direction perpendicular to the first direction to a final area stretch ratio of about 40:1. Samples were immediately removed from the stretching machine to cool. The film had a nominal thickness of about 0.030 cm. The film was slit into useful sample widths using a razor blade cutter equipped with fresh blades.

15

Examples 10-16 were prepared by stretching the cast sheet described above simultaneously in two perpendicular directions using a laboratory two-way film stretching machine known as a frame or batch stretcher as follows. The cast film sheet of 0.16 cm thickness was cut into square tablets of 6.83 cm on a side and held in the stretching oven of the batch stretcher by edgewise gripping with a series of clips to leave a stretchable sample of 5.08 cm on a side. The tablet was pre-heated for 90 seconds at 155° C, then

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simultaneously stretched at a rate of about 300%/sec in the reference direction and about 300%/sec in the direction perpendicular to the reference direction to a final area stretch ratio of 50:1. The film was slit into useful sample widths using a razor blade cutter equipped with fresh blades.

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Samples prepared in accordance with Examples 1-10, 12-13, and 15-16 were tested for severability by the Dispense Test - Metal Blade. Samples prepared in accordance with Examples 5, 7, and 10-15 were tested for severability by the Dispense Test - Plastic Blade. Samples from each Example were also tested for melt flow rate and weight average molecular weight Mw by the methods described above. Samples from each Example were also tested for tensile elongation at break by the method described above.

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Table 2: Test Results

	Ex.	MFR ¹	Mw ²	PI ³	Test ⁴	Peak ⁵	Energy ⁶	Tensile Elong. ⁷	Dispense Elong. ⁸	Haze ⁹
10	1	4.4	420		M	19.5	600	190	3.18	1.06
	2	5.4	490		M	19.1	561	188	2.97	0.91
	3	8.0	420		M	14.1	241	167	1.80	0.07
	4	11.2	350		M	13.2	235	167	1.86	0.47
	5	5.8			M	22.4	740	98	3.70	4.56
	6				M	16.9	270	109	1.88	3.30
15	7	12.5			M	16.1	244	121	1.82	
	8	7.5			M	14.6	310	70	1.77	1.23
	9	19.6			M	12.8	249	55	1.56	0.79
	10	3.2	418	3.4	M	23.8	634	87	2.89	
	12	54.0	231	4.9	M	14.3	277	97	1.86	
	13	100.0	183	6.5	M	14.5	269	103	1.71	
20	15	49.0			M	17.0	285	90	1.86	
	16	45.0	224	4.9	M	15.5	248	86	1.72	
	5	5.8	197		P	29.8	937	98	3.20	4.56
	7	12.5	132		P	26.7	591	121	2.49	3.30
	10	3.2	418	3.4	P	43.1	3370	87	7.31	
	11	6.7	320	4.1	P	38.3	2920	93	6.82	
25	12	54.0	231	4.9	P	20.8	532	97	1.86	
	13	100.0	183	6.5	P	17.2	286	103	1.71	
	14	6.9	249	4.9	P	34.2	1895	85	5.05	
	15	49.0			P	23.1	645	90	2.61	
	30									

1: Melt flow rate reported in grams/10 minutes measured according to ASTM D 1238-95, Flow Rates of Thermoplastics by Extrusion Plastometer, Procedure B, Condition 230/2.16.

5 2: The weight average molecular weights (Mw) reported in 1000 grams/mole were measured using ASTM D 5296-92, Molecular Weight Averages by Size Exclusion Chromatography (SEC).

35 3: PI: Polydispersity Index = $10^6/G_c$ where G_c = rheometer crossover modulus value (dyne/cm²).

40 4: M = Dispense Test - Metal Blade; P = Dispense Test - Plastic Blade.

5: Peak load measured during Dispense Test, reported as (N/19.1 mm).

45 6: Energy to dispense measured by Dispense Test - Metal Blade, and/or Dispense Test - Plastic Blade, and reported as N-cm/cm².

7: Tensile elongation-at-break was measured by the procedures described in ASTM D-882-95A, "Tensile Properties of Thin Plastic Sheeting," Method A and is reported in percent.

15 8: Elongation measured during Dispense Test - Metal Blade, and/or Dispense Test - Plastic Blade, reported in percent.

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5 9: Measured by ASTM D1003-95 and reported in percent.

10 The tests and test results described above are intended solely to be illustrative, rather than predictive, and variations in the testing procedure can be expected to yield different results.

15 5 The present invention has now been described with reference to several embodiments thereof. The foregoing detailed description and examples have been given for clarity of understanding only. No unnecessary limitations are to be understood therefrom. The disclosures of all patents and patent applications cited herein are hereby incorporated by reference. It will be apparent to those skilled in the art that many changes
20 10 can be made in the embodiments described without departing from the scope of the invention. Thus, the scope of the present invention should not be limited to the exact details and structures described herein, but rather by the structures described by the language of the claims, and the equivalents of those structures.

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Claims

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WHAT IS CLAIMED IS:

1. An adhesive tape comprising:

a backing and a layer of adhesive on said backing;

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wherein said backing has an energy to sever of up to 700 N-cm/cm² when severed

5 according to The Dispense Test - Plastic Blade; and

15 wherein said backing comprises a biaxially oriented substrate, whercin said biaxially oriented substrate comprises an isotactic polypropylene composition, and wherein said biaxially oriented substrate has a melt flow rate of at least 8.

20 2. The adhesive tape of claim 1, wherein said biaxially oriented substrate comprises a monolayer substrate.

25 3. The adhesive tape of claim 1, wherein said biaxially oriented substrate comprises a multilayer film, and wherein with respect to the total thickness of said biaxially oriented substrate, at least 50% of the thickness of said biaxially oriented substrate comprises at least 90% isotactic polypropylene.

30 4. The adhesive tape of claim 3, wherein a first plurality of said layers each comprise at least 90% isotactic polypropylene, and wherein said first plurality of layers comprise at least 50% of the total thickness of said biaxially oriented substrate.

35 5. The adhesive tape of claim 1, whercin said biaxially oriented substrate has a weight average molecular weight of at least 100,000 grams/mole.

20 6. The adhesive tape of claim 1, whercin said backing has an elongation of up to 4% when severed according to The Dispense Test - Plastic Blade.

40 7. The adhesive tape of claim 1, wherein said backing has an energy to sever of up to 350 N-cm/cm² when severed according to The Dispense Test - Metal Blade.

25 8. The adhesive tape of claim 7, wherein said backing has an elongation of up to 4% when severed according to The Dispense Test - Metal Blade.

45 9. The adhesive tape of claim 1, wherein said backing has a tensile elongation to break of from 40% to 170%.

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5 10. The adhesive tape of claim 1, wherein said biaxially oriented substrate has a melt flow rate of at least 12.

10 11. The adhesive tape of claim 10, wherein said biaxially oriented substrate has a melt flow rate of at least 20.

5 12. The adhesive tape of claim 1, wherein said biaxially oriented substrate has a melt flow rate of from 8 to 100.

15 13. The adhesive tape of claim 1, wherein said polypropylene composition has a weight average molecular weight of at least 100,000 grams per mole.

10 14. The adhesive tape of claim 1, wherein said polypropylene composition has an isotacticity greater than about 90%.

20 15. The adhesive tape of claim 1, wherein said polypropylene composition has a melt flow rate of at least 8.

25 16. The adhesive tape of claim 15, wherein said polypropylene composition has a melt flow rate of at least 12.

15 17. The adhesive tape of claim 16, wherein said polypropylene composition has a melt flow rate of at least 20.

30 18. The adhesive tape of claim 15, wherein said polypropylene composition has a melt flow rate of from 8 to 100.

35 19. The adhesive tape of claim 1, wherein said polypropylene composition comprises a blend of a first isotactic polypropylene having a first melt flow rate and a second isotactic polypropylene having a second melt flow rate greater than said first melt flow rate.

40 20. The adhesive tape of claim 19, wherein said first melt flow rate is about 0.5 - 8.0 and wherein said second melt flow rate is at least 8.0.

45 21. The adhesive tape of claim 20, wherein said second melt flow rate is at least 50.

50 22. The adhesive tape of claim 20, wherein said second melt flow rate is up to about 150.

5 23. The adhesive tape of claim 22, wherein said first melt flow rate is about 0.5 to
5.

10 24. The adhesive tape of claim 19, wherein said first polypropylene has a weight
average molecular weight of at least 350,000 and said second polypropylene has a weight
5. average molecular weight of at least 100,000.

15 25. The adhesive tape of claim 1, wherein said biaxially oriented substrate has
been oriented to a final area stretch ratio of at least 36:1.

20 26. The adhesive tape of claim 25, wherein said biaxially oriented substrate has
been simultaneously biaxially oriented.

25 27. The adhesive tape of claim 25, wherein said biaxially oriented substrate has
been sequentially biaxially oriented.

30 28. The adhesive tape of claim 1, wherein said adhesive comprises a pressure
sensitive adhesive

35 29. The adhesive tape of claim 28, wherein said adhesive tape is spirally wound so
as to provide a roll of tape.

40 30. The adhesive tape of claim 29, wherein said roll is mounted on a dispenser
including a metal cutting blade.

45 31. The adhesive tape of claim 29, wherein said roll is mounted on a dispenser
including a plastic cutting blade.

50 32. An assembly of a roll of pressure sensitive adhesive tape mounted on a
dispenser, the assembly comprising:

55 a) a roll of pressure sensitive adhesive tape, said tape comprising a backing and a
layer of pressure sensitive adhesive on said backing;

40 i) wherein said backing has an energy to sever of up to 700 N-cm/cm²
25 when severed according to The Dispense Test - Plastic Blade;

45 ii) wherein said backing has an elongation of up to 4% when severed
according to The Dispense Test - Plastic Blade;

50 iii) wherein said backing has an elongation to break of from 40% to 170%;
and

- 5 iv) wherein said backing comprises a biaxially oriented substrate, wherein
said biaxially oriented substrate comprises an isotactic polypropylene composition
having an isotacticity of at least 90%, and wherein said biaxially oriented substrate
has a melt flow rate of at least 20; and
- 10 5 b) a dispenser, said dispenser including a roll mount having said roll of tape
rotatably mounted theron, and a plastic serrated cutting blade for severing said adhesive
tape.
- 15 15 33. The assembly of claim 32, wherein said biaxially oriented substrate comprises
a monolayer substrate.
- 20 20 34. An adhesive tape comprising:
a backing and a layer of adhesive on said backing;
wherein said backing has an energy to sever of up to 350 N·cm/cm² when severed
according to The Dispense Test - Metal Blade; and
- 25 25 wherein said backing comprises a biaxially oriented substrate, wherein said
biaxially oriented substrate comprises an isotactic polypropylene composition, and
wherein said biaxially oriented substrate has a melt flow rate of at least 8.
- 30 30 35. The adhesive tape of claim 34, wherein said biaxially oriented substrate
comprises a monolayer substrate.
- 35 35 36. The adhesive tape of claim 34, wherein said biaxially oriented substrate
comprises a multilayer film, and wherein with respect to the total thickness of said
biaxially oriented substrate, at least 50% of the thickness of said biaxially oriented
substrate comprises at least 90% isotactic polypropylene.
- 40 40 37. The adhesive tape of claim 36, wherein a first plurality of said layers each
comprise at least 90% isotactic polypropylene, and wherein said first plurality of layers
comprise at least 50% of the total thickness of said biaxially oriented substrate.
- 45 45 38. The adhesive tape of claim 34, wherein said biaxially oriented substrate has a
weight average molecular weight of at least 100,000 grams/mole.
- 50 50 39. The adhesive tape of claim 34, wherein said backing has an elongation of up to
4% when severed according to The Dispense Test - Metal Blade.

- 5 40. The adhesive tape of claim 34, wherein said backing has a tensile elongation to
break of from 40% to 170%.
- 10 41. The adhesive tape of claim 34, wherein said biaxially oriented substrate has a
melt flow rate of at least 12.
- 15 5 42. The adhesive tape of claim 41, wherein said biaxially oriented substrate has a
melt flow rate of at least 20.
- 20 15 43. The adhesive tape of claim 34, wherein said biaxially oriented substrate has a
melt flow rate of from 8 to 100.
- 25 10 44. The adhesive tape of claim 34, wherein said polypropylene composition has an
isotacticity greater than about 90%.
- 30 20 45. The adhesive tape of claim 34, wherein said polypropylene composition has a
melt flow rate of at least 8.
- 35 25 46. The adhesive tape of claim 45, wherein said polypropylene composition has
melt flow rate of at least 12.
- 40 30 47. The adhesive tape of claim 46, wherein said polypropylene composition has a
melt flow rate of at least 20.
- 45 35 48. The adhesive tape of claim 45, wherein said polypropylene composition has a
melt flow rate of from 8 to 100.
- 50 40 49. The adhesive tape of claim 34, wherein said polypropylene composition
comprises a blend of a first isotactic polypropylene having a first melt flow rate and a
second isotactic polypropylene having a second melt flow rate greater than said first melt
flow rate.
- 55 45 50. The adhesive tape of claim 49, wherein said first melt flow rate is about 0.5 -
8.0 and wherein said second melt flow rate is at least 8.0.
- 60 50 51. The adhesive tape of claim 50, wherein said second melt flow rate is at least
50.
- 65 55 52. The adhesive tape of claim 50, wherein said second melt flow rate is up to
about 150.

5 53. The adhesive tape of claim 51, wherein said first melt flow rate is about 0.5 to
5.

10 54. The adhesive tape of claim 49, wherein said first polypropylene has a weight
5 average molecular weight of at least 350,000 and said second polypropylene has a weight
average molecular weight of at least 100,000.

15 55. The adhesive tape of claim 34, wherein said biaxially oriented substrate has
been oriented to a final area stretch ratio of at least 36:1.

20 56. The adhesive tape of claim 55, wherein said biaxially oriented substrate has
been simultaneously biaxially oriented.

25 57. The adhesive tape of claim 55, wherein said biaxially oriented substrate has
been sequentially biaxially oriented.

30 58. The adhesive tape of claim 34, wherein said adhesive comprises a pressure
sensitive adhesive.

35 59. The adhesive tape of claim 58, wherein said adhesive tape is spirally wound so
15 as to provide a roll of tape.

40 60. The adhesive tape of claim 59, wherein said roll is mounted on a dispenser
including a metal cutting blade.

45 61. The adhesive tape of claim 59, wherein said roll is mounted on a dispenser
including a plastic cutting blade.

50 62. An adhesive tape backing comprising a biaxially oriented substrate, wherein
20 said biaxially oriented substrate comprises an isotactic polypropylene composition,
35 wherein said biaxially oriented substrate has a melt flow rate of at least 8, and wherein
 said backing has an energy to sever of up to 700 N-cm/cm² when severed according to The
40 Dispense Test - Plastic Blade.

55 63. The adhesive tape backing of claim 62, wherein said biaxially oriented
 substrate comprises a monolayer substrate.

60 64. The adhesive tape backing of claim 62, wherein said biaxially oriented
 substrate comprises a multilayer film, and wherein with respect to the total thickness of
 said biaxially oriented substrate, at least 50% of the thickness of said biaxially oriented
 substrate comprises at least 90% isotactic polypropylene.

- 5 65. The adhesive tape backing of claim 64, wherein a first plurality of said layers
each comprise at least 90% isotactic polypropylene, and wherein said first plurality of
layers comprise at least 50% of the total thickness of said biaxially oriented substrate.
- 10 66. The adhesive tape backing of claim 62, wherein said biaxially oriented
substrate has a weight average molecular weight of at least 100,000 grams/mole.
- 15 67. The adhesive tape backing of claim 62, wherein said backing has an
elongation of up to 4% when severed according to The Dispense Test - Plastic Blade.
- 20 68. The adhesive tape backing of claim 62, wherein said backing has a tensile
elongation to break of from 40% to 170%.
- 25 69. The adhesive tape backing of claim 62, wherein said biaxially oriented
substrate has a melt flow rate of at least 12.
- 30 70. The adhesive tape backing of claim 69, wherein said biaxially oriented
substrate has a melt flow rate of at least 20.
- 35 71. The adhesive tape backing of claim 62, wherein said biaxially oriented
substrate has a melt flow rate of from 8 to 100.
- 40 72. The adhesive tape backing of claim 62, wherein said polypropylene
composition has a weight average molecular weight of at least 100,000 grams per mole.
- 45 73. The adhesive tape backing of claim 62, wherein said polypropylene
composition has an isotacticity greater than about 90%.
- 50 74. The adhesive tape backing of claim 62, wherein said polypropylene
composition has a melt flow rate of at least 8.
- 55 75. The adhesive tape backing of claim 74, wherein said polypropylene
composition has melt flow rate of at least 12.
- 60 76. The adhesive tape backing of claim 75, wherein said polypropylene
composition has a melt flow rate of at least 20.
- 65 77. The adhesive tape backing of claim 74, wherein said polypropylene
composition has a melt flow rate of from 8 to 100.

5 78. The adhesive tape backing of claim 62, wherein said polypropylene
composition comprises a blend of a first isotactic polypropylene having a first melt flow
rate and a second isotactic polypropylene having a second melt flow rate greater than said
first melt flow rate.

10 5 79. The adhesive tape backing of claim 78, wherein said first melt flow rate is
about 0.5 - 8.0 and wherein said second melt flow rate is at least 8.0.

15 10 80. The adhesive tape backing of claim 79, wherein said second melt flow rate is
at least 50.

10 15 81. The adhesive tape backing of claim 79, wherein said second melt flow rate is
up to about 150.

20 20 82. The adhesive tape backing of claim 81, wherein said first melt flow rate is
about 0.5 to 5.

25 25 83. The adhesive tape backing of claim 78, wherein said first polypropylene has a
weight average molecular weight of at least 350,000 and said second polypropylene has a
15 25 weight average molecular weight of at least 100,000.

30 30 84. The adhesive tape backing of claim 62, wherein said biaxially oriented
substrate has been oriented to a final area stretch ratio of at least 36:1.

35 35 85. The adhesive tape backing of claim 84, wherein said biaxially oriented
substrate has been simultaneously biaxially oriented.

40 40 86. The adhesive tape backing of claim 84, wherein said biaxially oriented
substrate has been sequentially biaxially oriented.

45 45 87. The adhesive tape backing of claim 62, further comprising a layer of adhesive
on said backing.

50 50 88. The adhesive tape backing of claims 87, wherein said adhesive comprises a
pressure sensitive adhesive.

55 55 89. The adhesive tape backing of claim 88, wherein said adhesive tape is spirally
wound so as to provide a roll of tape.

55 55 90. The adhesive tape backing of claim 89, wherein said roll is mounted on a
dispenser including a metal cutting blade.

5 91. The adhesive tape backing of claim 89, wherein said roll is mounted on a
dispenser including a plastic cutting blade.

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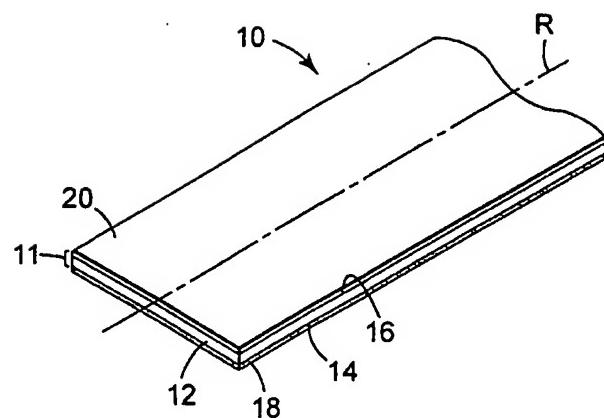


Fig. 1

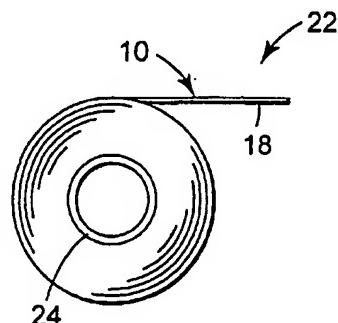


Fig. 2

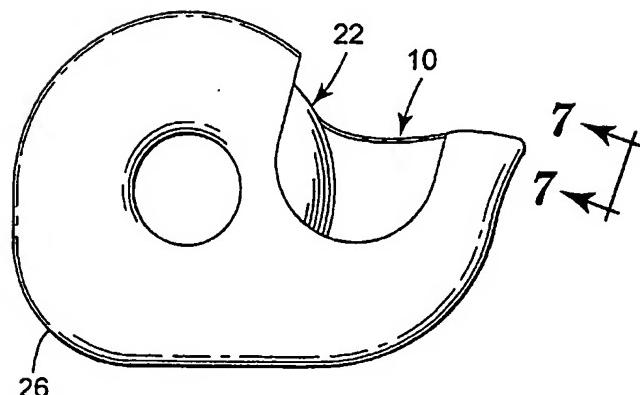


Fig. 3

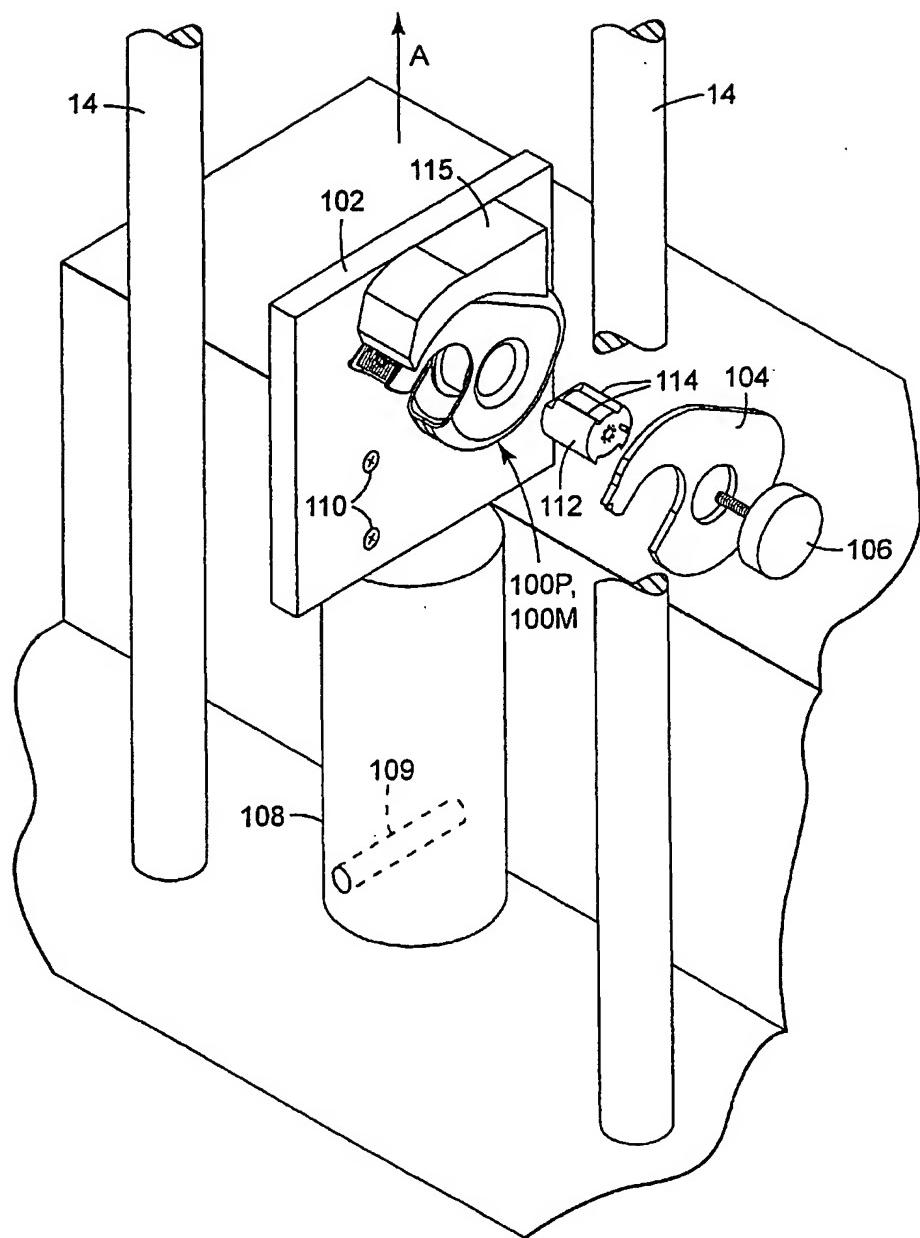


Fig. 4

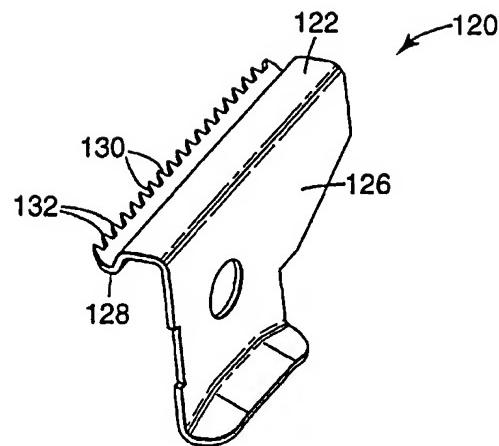


Fig. 5

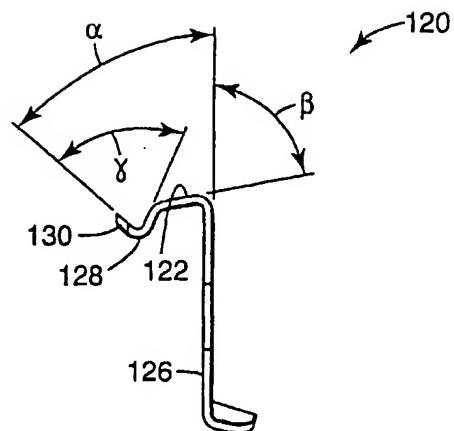


Fig. 6

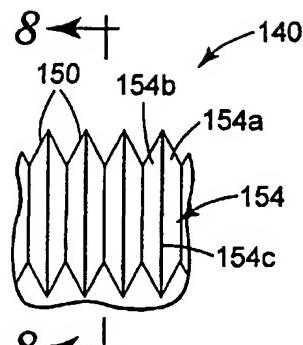


Fig. 7

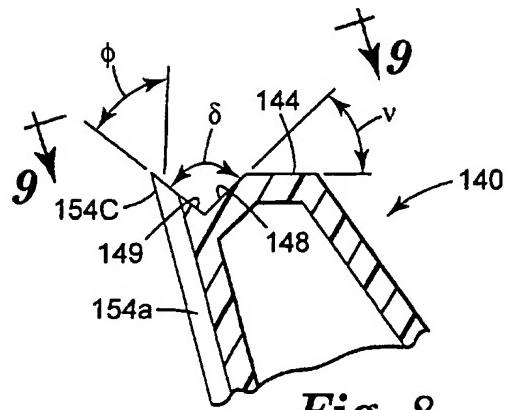


Fig. 8

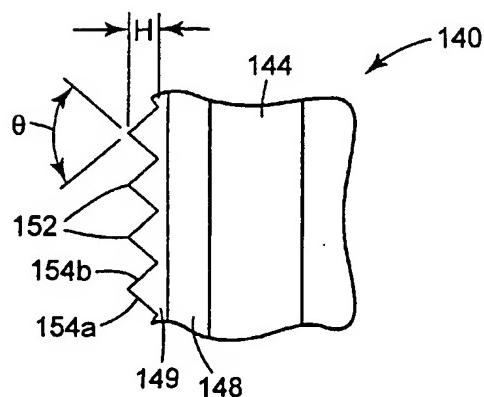


Fig. 9

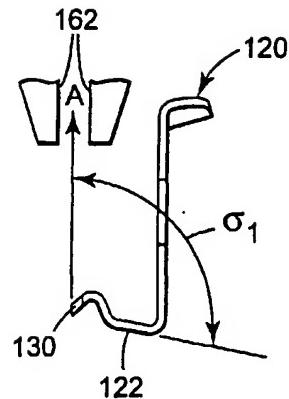


Fig. 10

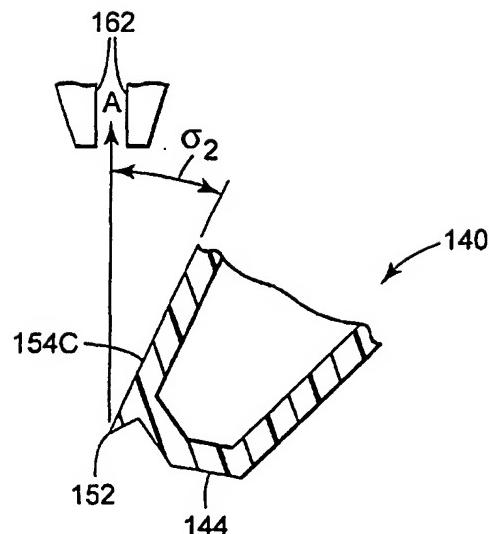


Fig. 11

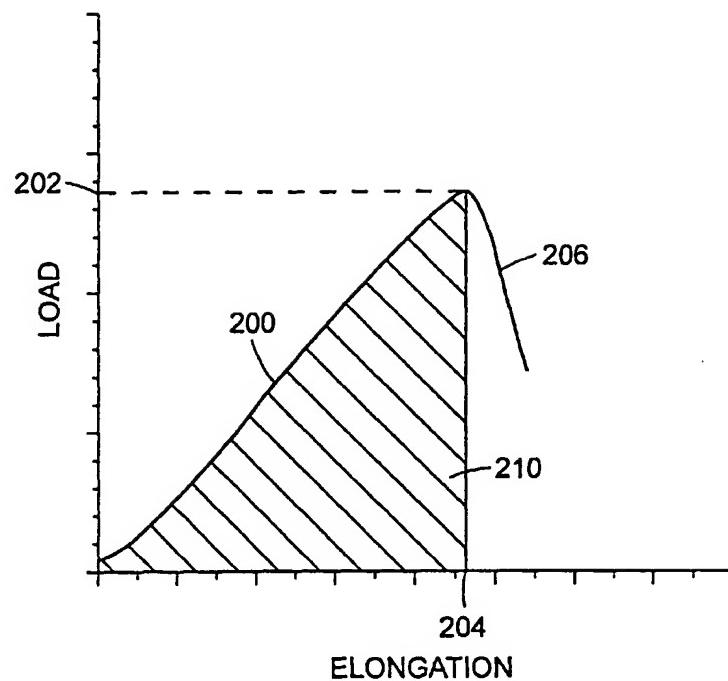


Fig. 12

INTERNATIONAL SEARCH REPORT

Int'l. Search Application No PCT/US 98/24105

A. CLASSIFICATION OF SUBJECT MATTER IPC 6 C09J7/02 C08J5/18 B32B27/32

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 6 C09J C08

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	<p>DATABASE WPI Section Ch, Week 9329 Derwent Publications Ltd., London, GB: Class A17, AN 93-231949 XP002107479 & JP 05 154905 A (TORAY IND INC) , 22 June 1993</p> <p>see abstract</p> <p>---</p> <p>US 3 324 218 A (HORST GEBLER ET AL) 6 June 1967 cited in the application see column 1, line 56 - line 67 see column 2, line 26 - line 28; example see claims; figure 1</p> <p>---</p> <p>-/-</p>	<p>1,2, 5-18,25, 27,34, 35, 38-48, 55,57, 62,63, 66-77, 84,86,87</p>
X		<p>62,63, 66-77, 84,86,87</p>

Further documents are listed in the continuation of box C.

Patent family members are listed in annex.

* Special categories of cited documents :

- "A" document defining the general state of the art which is not considered to be of particular relevance
- "E" earlier document but published on or after the international filing date
- "L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
- "O" document referring to an oral disclosure, use, exhibition or other means
- "P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the International filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

"&" document member of the same patent family

Date of the actual completion of the international search

Date of mailing of the international search report

28 June 1999

07/07/1999

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Authorized officer

De Jonge, S

INTERNATIONAL SEARCH REPORT

International Application No
PCT/US 98/24105

C(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT		
Category	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	EP 0 459 059 A (MINNESOTA MINING & MFG) 4 December 1991 see page 4, line 29 - line 35 see claims; figures 1-3 -----	1-91
A	US 4 451 533 A (WONG ROY ET AL) 29 May 1984 cited in the application see column 2, line 59 - column 3, line 7; claims; examples 1,5,6,8 -----	1-91
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